# Integrated Water Resources Science and Services
# Ohio River Basin Stakeholder Report
# June 25 and 26, 2014

## Executive Summary

On June 25 and 26, 2014, the NOAA National Weather Service, in cooperation with the Ohio River Valley Water Sanitation Commission (ORSANCO), convened two one-day stakeholder meetings in Cincinnati, Ohio (Upper Basin), and Nashville, Tennessee (Lower Basin). The Lower Basin was generally defined to include the Tennessee, Cumberland, Wabash, and Green River watersheds; the Upper Basin included the remainder of the Ohio River watershed, generally the area north of the Lower Basin watersheds. The meetings, which included 57 representatives from national, regional, state and local organizations were convened as part of a national initiative called the Integrated Water Resources Science and Services (IWRSS). The IWRSS Federal partner agencies are NOAA National Weather Service, the U.S. Geological Survey and the U.S. Army Corps of Engineers. At these stakeholders' meetings, participants learned about hydrologic services IWRSS can provide, identified key gaps that IWRSS might fill to inform water resources decision-making, and discussed possible demonstration projects to build capacity for enhanced integrated water resources management in the Ohio River Basin.

In advance of the meetings, participants were polled to determine the highest priority resources issues for the basin. Three issues of greatest interest rose to the top in each poll:

Upper Basin:

- Water quality
- Water supply
- Fish and aquatic habitat

Lower Basin:

- Water quality
- Water supply
- Flooding

During the meetings, participants were divided into issue-based groups reflecting the above priorities to identify key decisions, questions, and gaps that IWRSS could address. At both meetings, there were common gaps across two or more of the issue groups:

- Valuation (of water and ecosystem services)
- Projections and predictions related to climate change
- Water consumption and withdrawal management
- Data integration

Each issue-based group proposed a pilot project that would demonstrate how these key information gaps could be filled to address priority issues. The three pilot projects for each meeting are summarized below.

Upper Basin (Cincinnati):

Project #1: **(Water Supply)** Develop a model for water budget (water in/out) including future climate change scenarios, a common central data portal, and GIS capability.

Project #2: **(Water Quality)** Develop a decision support system initially focused on spill response.

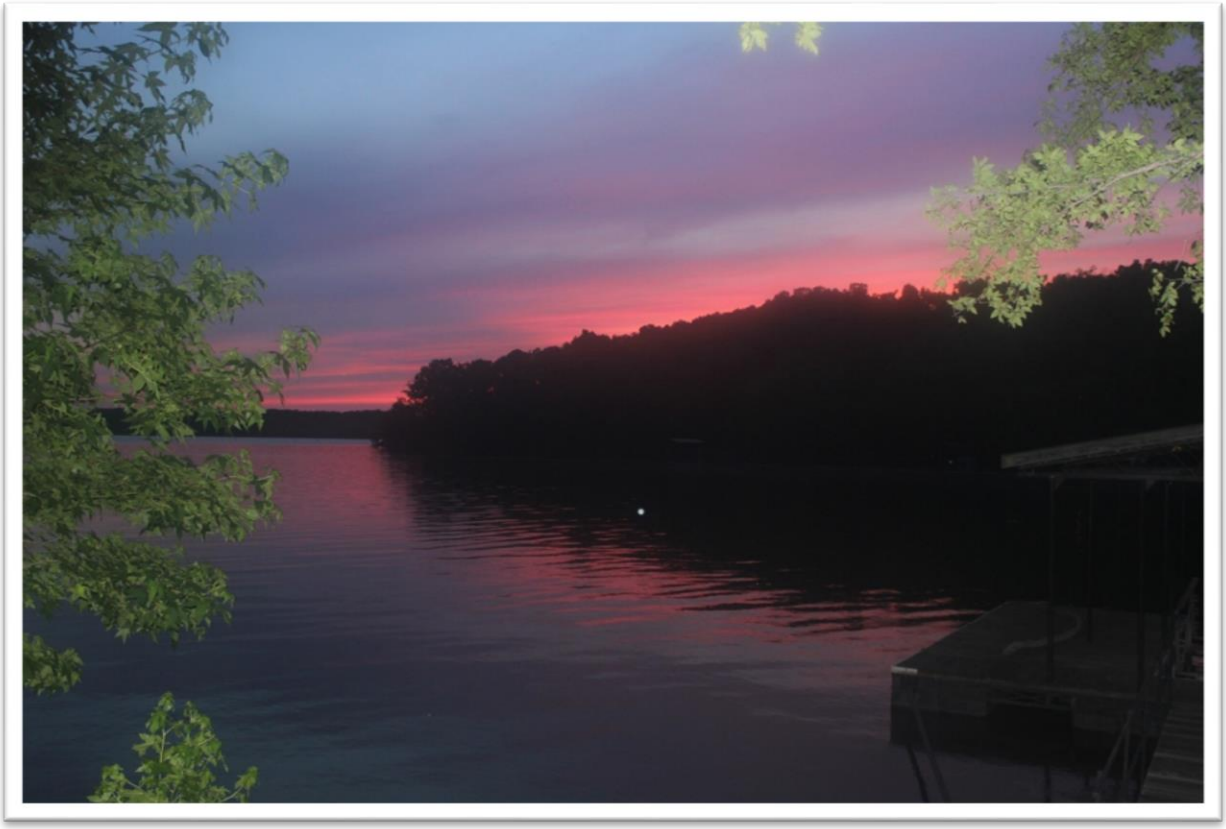
Project #3: **(Fish and Aquatic Habitat)** Prepare requirements for a database and data services system to help establish the value of aquatic habitats.

Lower Basin (Nashville):

Project #1: **(Water Quality)** Develop a predictive tool that uses climate change and land use data to evaluate, predict, and demonstrate effects of land management practices on water supply and water quality.

Project #2: **(Water Supply**) Modeling and interpretation of future scenarios showing uncertainty in water supply, demand, and ecological requirements due to climate change.

Project #3: **(Flooding)** Citizen-scientist data collection involving schools and leveraging private sector funding to develop data to enhance modeling and raise awareness.



**Sunset over Lake Barkley, Kentucky-Tennessee border.** ***Photo: Bob Sneed, USACE***

# List of Acronyms

| | |
|---|---|
| ADM | Archer Daniels Midland Company |
| API | Application programming interface |
| BMP | Best management practice |
| DO | Dissolved oxygen |
| DOI | U.S. Department of the Interior |
| DOT | U.S. Department of Transportation |
| EPA | Environmental Protection Agency |
| EPRI | Electric Power Research Institute |
| FEMA | Federal Emergency Management Agency |
| GIS | Geographic information system |
| HEC-RAS | Hydrologic Engineering Centers River Analysis System |
| IRIS | Integrated Risk Information System (EPA) |
| IWRSS | Integrated Water Resource Science and Services |
| LIDAR | Light detection and ranging |
| MPO | Metropolitan Planning Organization |
| NGO | Non-governmental organization |
| NOAA | National Oceanic and Atmospheric Administration |
| NPS | Non-point source |
| NRCS | Natural Resources Conservation Service (USDA) |
| NWS | National Weather Service (NOAA) |
| OKI | Ohio-Kentucky-Indiana Regional Council of Governments |
| ORSANCO | Ohio River Valley Water Sanitation Commission |
| PS | Point source |
| TMDL | Total maximum daily load |
| TVA | Tennessee Valley Authority |
| USACE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USFWS | U.S. Fish and Wildlife Service (DOI) |
| USGS | U.S. Geological Survey |

# Ohio River Basin

## *Purpose of the Meetings*

On June 25 and 26, 2014, the NOAA National Weather Service, in cooperation with the Ohio River Valley Water Sanitation Commission (ORSANCO), and in coordination with the IWRSS Federal partner agencies, convened two one-day stakeholders' meetings in Cincinnati, Ohio (Upper Basin), and Nashville, Tennessee (Lower Basin). The Lower Basin was defined to include the Tennessee, Cumberland, Wabash, and Green River watersheds while the Upper Basin included watersheds generally north of the Lower Basin.

The meetings involved 57 representatives from national, regional, state and local organizations. The meetings were part of a stakeholder needs analysis for a new national business model called the Integrated Water Resources Science and Services (IWRSS). The IWRSS Federal partner agencies are NOAA National Weather Service, the U.S. Geological Survey and the U.S. Army Corps of Engineers. At these stakeholders' meetings, participants learned about hydrologic services IWRSS can provide, identified key gaps that IWRSS might fill to inform water resources decision-making, and discussed possible demonstration projects to build capacity for enhanced integrated water resources management in the Ohio River Basin.

Following is a summary of the discussion and recommendations from the forum.

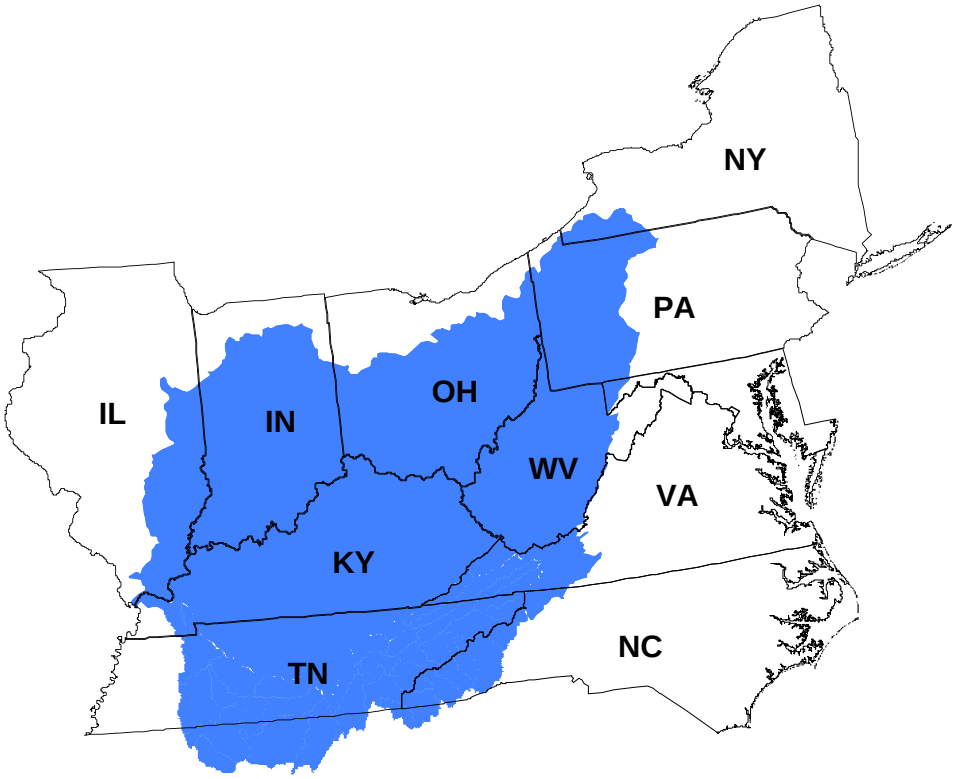



**Figure 1: Ohio River Basin drains portions of 14 states and 204,000 square miles.**

## *Priority Water Resources Issues in the Upper and Lower Ohio River Basin*

The IWRSS team developed an issues paper describing priority water resource issues for the Ohio River Basin based on a review of EPA, ORSANCO, and USACE reports and in consultation with ORSANCO. The IWRSS team then shared the list of issues with participants prior to the stakeholders' meeting. As part of the forum registration process, participants were asked to indicate their top three highest priorities (with the option of writing in additional suggestions). Priority issues for the Upper Ohio River Basin, along with the number of votes received (indicated in parentheses), are listed below.

- Water Quality (29)
    - Impacts from runoff by land use conversions and combined sewer overflows; water quality effects on threatened and endangered species; pharmaceuticals, bacteria, pesticides, nutrient loading, and sedimentation; lack of basin stormwater management; and the need for water treatment/distribution and sewage collection/treatment infrastructure.
- Water Supply /Water Withdrawals/Water Management (18)
    - Sufficiency of water supplies in view of projected population increases and climate change; bank erosion due to flow regulation at reservoirs, navigation locks, and dams; conflicts among water users (i.e., water supply, hydropower, recreation, flood protection, fish and wildlife, and navigation); better management of water storage and flows; and out-of-basin water transfers for water supply and other uses.
- Fisheries and Aquatic Habitat (14)
    - Lack of ecological connectivity between the rivers/floodplains; regulated flow from reservoirs reduces aquatic species habitat diversity and productivity; effects of sedimentation on aquatic species including game fish and their food sources; invasive species effects on indigenous aquatic and terrestrial species in the basin; and changes to river flow regimes, temperature and nutrient dynamics of the river system has affected some fisheries.
- Flooding (12)
    - Need for additional flood protection at basin-wide major cities and smaller communities; need to update floodplain mapping to better manage development; fiscal sustainability of streamflow gages in the basin that are critical to flood warning systems and drought monitoring.
- Climate Change/Drought (11)
    - Potential effects of climate change on threatened and endangered species habitat, recreational use, water supplies and agriculture.

- Energy Production (10)
    - Water quality and quantity impacts associated with exploration of the Marcellus shale; concerns about impacts of transporting fracking wastes along Ohio River and other waterways; hydropower facilities' impact on aquatic life by causing mortality to fish that pass through the facility's turbines; diversion of river flow through a hydropower facility.
- Maintaining Hydrology (5)
    - Dredging and maintenance of navigation channels is continually needed for commercial navigation. New commodities and freight prospects in the Ohio River place added importance on the navigation system and connections to Gulf Coast ports, and repair and rehabilitation of aging flood control infrastructure is a major concern.
- Other (3)

Results of voting for the Lower Ohio River Basin (with the number of votes indicated in parentheses), appears below.

- Water Quality (11)
- Water Supply (11)
- Flooding (9)
- Hydrology (8)
- Climate Change (8)
- Fisheries and Aquatic Habitat (3)
- Energy Production (2)
- Other (1)

Results of the participant poll were summarized and formed the basis for discussion about priority issues at each meeting.

## Top Three Water Resources Issues:

### Water Quality (Both Lower and Upper Basin)

Water quality issues in the Ohio River Basin are focused on point and non-point source pollution from multiple sources including urban runoff, agriculture, and abandoned mines. Some of the specific issues included:

- Impacts from runoff by land use conversions and combined sewer overflows;

- Water quality effects on threatened and endangered species (especially mussels) in the Ohio River and tributaries;
- Pharmaceuticals, bacteria, pesticides, nutrient loading, and sedimentation;
- Lack of basin stormwater management (generates flooding conditions downstream as well as water-quality problems); and
- Need for water treatment/distribution and sewage collection/treatment infrastructure.

**Water Supply (Both Lower and Upper Basin)**

This priority issue centered on the importance of the Ohio River Basin in providing critical water supplies for millions of residents and numerous industries. Some of the specific topics stakeholders were asked to consider included:

- Adequacy of water supplies in view of projected population increases and climate change;
- Bank erosion due to flow regulation at reservoirs, navigation locks, and dams;
- Conflicts among water users (i.e., water supply, hydropower, recreation, flood protection, fish and wildlife, and navigation);
- Better management of water storage and flows; and
- Out-of-basin water transfers for water supply and other uses.

**Fish and Aquatic Habitat (Upper Basin only)**

This priority issue was focused on the role of the Ohio River Basin in supporting diverse communities of fish and other aquatic organisms. Some of the specific topics stakeholders were asked to consider included:

- Lack of ecological connectivity between the rivers/floodplains;
- Regulated flow from reservoirs reduces aquatic species habitat diversity and productivity;
- Effects of sedimentation on aquatic species including game fish and their food sources;
- Invasive species effects on indigenous aquatic and terrestrial species in the basin; and
- Changes to river flow regimes; temperature and nutrient dynamics of the river system has affected some fisheries.

**Flooding (Lower Basin only)**

This priority issue involved the dangers and damages caused by flooding along the Lower Basin Rivers and their tributaries. Some of the specific topics stakeholders were asked to consider included:

- Need for additional flood protection across the basin for major cities and smaller communities that are impacted;
- Need to update floodplain mapping to better manage development; and
- Need to maintain and improve coverage of stream gages in the basin that are critical to flood warning systems and drought monitoring.

## *Stakeholders' Meetings*

### Opening Plenary Session

Mary Mullusky (Acting Chief, NWS Hydrologic Services Division) and Sam Dinkins (ORSANCO Water Resources Assessment Manager) laid the groundwork for each day by providing an overview of IWRSS and Ohio River Basin priority issues, respectively.

In preparation for breakout groups, participants generally discussed each of the top three priority issues and expressed their views and questions about how IWRSS might help address the issues they are currently facing, or may face in the future. From this discussion the following topics, concerns, and questions emerged.

## Cincinnati Meeting

### *Water Quality*

- Urban redevelopment in waterfront areas often creates recreational opportunities in areas that do not meet *E. coli* (and other water quality) standards. It would be useful to have a tool for communicating these safety issues to the public, similar to the one used for Lake Erie.
- Need a better comprehensive understanding of the algal growth mechanism on the river main stem. This growth can cause operational problems for utilities and impact water quality.
- Having access to high-quality water-velocity data for tributaries would improve spill responses. This could be accomplished with new gages.
- Characteristics of stormwater runoff appear to be changing but we have limited information on parameters such as total organic carbon and other nutrients.
- Information on green infrastructure and other flood/water pollution mitigation sites (e.g., wetlands, riparian forests) is not aggregated at the local level. A better tracking and inventory systems would be useful for local watershed planning.

- More information is needed to evaluate how climate change will impact water temperatures to determine what this means for water quality and aquatic life.

- Bromide levels in the river resulting from Marcellus Shale drilling are a concern. See the February 2014 ORANSCO report entitled Characterization of Dissolved Solids in the Ohio River and Selected Tributaries.

- USGS and USACE are conducting a study comparing forecasts and hydraulic estimates to determine if gages are doing accurate job of measuring discharge.

- Concern was expressed that stricter air emissions regulations have resulted in power plants going from air-cooled to water-cooled systems, which has resulted in increased impacts on water quality (thermal discharge).

- Concern was expressed over lack of enforcement of private industry pollution.

### *Water Supply*

- America's Watershed Initiative is working on a report card for the Mississippi River Basin. One goal is to grade the economic potential of the watershed. The report card identified a lack of understanding of "cryptic" water transfers (i.e. water leaving the basin through products, livestock, energy, etc.).

- More research is needed on stream flashiness. Degree of flashiness (extreme short-term high water levels after a storm) is important for terrestrial and aquatic biota. Research, though limited, suggests that flashiness can be decreased by managing vegetation.

- Sediment accumulation caused by bank erosion is impacting reservoir management. Sedimentation from erosion also impacts aquatic life.

- Source water protection is critical for protecting drinking water supplies and includes identifying potential contamination sources upstream of public water supplies (e.g., above-ground storage tanks in West Virginia).

- Effluent releases are becoming increasingly important for maintaining streamflow during low flow periods. This means that flow in the river depends on the quality of effluent coming out of treatment plants. This trend will likely be more pronounced due to climate change.

- The Indiana Silver Jackets are conducting an erosion study in Indiana to capture changes in bank erosion based on intensity of events. This effort ties back to existing infrastructure (e.g. power lines) and ties into sediment transport as well.

- More information is needed to implement management changes in reservoir storage, releases, and dam operations to mitigate spills. Should more water be stored to lower flows during a spill? Or should higher flows be used to dilute the spill?

- Climate change will alter the hydrologic cycle and uniquely impact different areas of the Ohio River Basin. Tools are needed to better predict how these changes will impact different areas of the Basin.

### *Fish and Aquatic Habitat*

- Temperature change impacts on species are a major concern.

- More attention needs to be paid to ecological connectivity and more research is needed to evaluate the importance of certain species (e.g., cold water fish) to the ecosystem. Need solutions for managing these species; for example, we may need structural changes to allow species to survive.

- Some portions of the Ohio River Basin contain globally significant species (e.g., mussels in Green River). What are some ways to preserve these populations?

- Research on invasive species in riparian areas is needed to determine how they can affect the amounts of water and sediment. There are big differences in transpiration rates between invasive and native species.

## Nashville Meeting

### *Water Quality*

- Water quality is a rapidly changing issue because land use is changing and urbanization and industrial uses are increasing. When looking at costs and benefits of making changes to land use, it would be useful to have predictive tool to inform planning. How much improvement could we make in urban streams? Which areas are most likely to be successfully restored to provide the greatest benefit?

- Thermal impacts of Tennessee Valley Authority (TVA) operations are a daily issue/concern – specifically, temperature due to discharge from thermal plants and low dissolved oxygen (DO) levels. Both are monitored but TVA is always looking to improve. Model improvements are important for hydrothermal management.

- USACE is involved in water temperature and DO issues, such as those described above. USACE actively manages their upstream releases to provide the right cooling water to TVA plants at the right time. Those agencies work closely with the thermal modeling group in Knoxville. Dam safety issues have complicated management for water temperature.

- The Federal Clean Water Act does directly address non-point sources (NPS) of pollution. Education is a part of the solution, but only goes so far. Sediments and nutrients are the biggest concern. Right now, the focus is on showing water quality improvements. Point source dischargers make up a relatively small part of the watershed pollutants, but NPS are tough to deal with. Note: Pilot NPS/Point Source trading program is underway in the Ohio Basin. One idea is to come up with a trading project that is "BMP ready" once nutrient criteria are established. This would be a proactive approach so that a program is in place in time for the development of those standards. The program has tested some pilot trades, but it is a couple of years away from being operational.

### *Water Supply*

- TVA has multiple concerns including:
    - Permitting program: TVA can permit any permanent intake structures in their region. Their biggest concern is temporary (e.g., agricultural) withdrawals and how those withdrawals impact the permitted uses.
    - Drought impacts: The Cumberland River and its basin are considered a water rich region, however the drought of 2007 had some significant impacts with reservoirs falling below their intakes. What should we do when this occurs? Could we develop a tool to predict future drought and adjust intake levels accordingly?
    - TVA is currently operating without management plans for "outlier" events.
- A USACE reallocation study on water supplies is currently underway. What happens when the population grows to the point where there needs to be some tradeoffs? Need the ability to predict the required capacity of a new reservoir to account for competing needs (e.g., water supply contracts with municipalities).
- Currently there is no integrated water supply plan that exists for allocation purposes.
- Need better and more integrated information on users, supply, etc. to balance demand vs. supply.
- Climate change will complicate efforts to predict demand and supply. Example: City of Denver conducted a study on water supply in which a 5-degree increase in average temperature resulted in a 40 percent gap in supply vs. demand. Such information would be valuable in the Lower Basin for future planning.

### *Flooding*

- Need to work with stakeholder groups to better inform communities that have a difficult time making decisions regarding flooding (e.g., anticipate water levels, knowing how much water is flowing, how much rain is falling).
- Need real-time inundation downscaled mapping capability to show how a certain amount of rainfall in a one area would impact specific downstream areas.
- What does a community need to do to get coverage for real-time inundation mapping? USGS and NWS did this in 2010 in certain localities. The USACE along with their contractor AMEC, made some hard copy books with stage levels at intersections, critical areas that local emergency managers carried in the trunks of their cars. IWRSS could use this as a starting point to improve upon and modernize them.

## Morning and Afternoon Breakout Sessions

Following is a summary of the breakout group discussions. For the first breakout session, each group was asked to take on the following task:

*Identify up to three key decisions or outstanding questions (event-driven, high impact or important routine decision/question) that "keep you up at night".*

For each question/decision, identify key information gaps that need to be filled to inform these decisions (keeping in mind the capabilities of IWRSS).

For the second breakout session, each group was asked to develop a general scope for a potential project for their priority area to be considered as a possible IWRSS demonstration project. For each project, the groups were asked to provide a short narrative describing the project, identify key benefits of the project to help make the business case for implementing it, and determine what partner organizations and agencies would need to be involved to undertake the project.

***Photo: Bob Sneed, USACE***

## Summary of Cincinnati Break Out Group Discussions

Participants in each group are listed below (the full participant list can be found in Appendix A).

| Water Quality | Water Supply | Fish and Aquatic Habitat |
|---|---|---|
| Bruce Whitteberry | Emily Class | Rich Cogen |
| Mindy Scott | Scott Kirk | Michael Miller |
| Greg Nageotte | Brian A. Carr | Kristy Hopfensperger |
| Scott Jackson | John Menninger | Trent Schade |
| Elly Best | Ben Haggerty | Judith Petersen |
| Christina Baysinger | Mike Griffin | Teresa Harten |
| Mike Ekberg | Gary Springston | |
| Erich Emery | Bill Caldwell | |
| John Mangan | Tara Lanier | |
| Tre Sheldon | Jim Noel | |
| Jason Heath | Chuck Somerville | |
| Ted Lozier | Sam Dinkins | |
| Evelyn Hartzell | | |
| Jim Goodrich | | |

## Water Quality

### *Key Decisions/Questions and Gaps that IWRSS Could Fill*

**Decision 1:** Are policies for preparation and emergency response to upstream spills/accidental releases adequate?

**Gaps:**

- Better knowledge of downstream travel time, contaminant concentrations, and resulting impacts (i.e., human and aquatic community health effects, treatability, etc.) of upstream spills.
- Spatial information on potential sources of spills (e.g., high risk land uses, transportation crossings, key outfall/discharge locations).
- Better understanding of downstream vulnerability (e.g. at drinking water intakes, sensitive habitats).

**Decision #2:** How to manage risks and impacts of known/permitted point and nonpoint discharges?

**Gaps:**

- Need reservoir storage/release and dam operation procedures to optimize for water quality considerations (currently releases are determined based on only flood control and navigation-related objectives).
- Need more stream gages and land use information over a wider area (e.g., in upstream tributaries).

**Decision #3:** With increased recreations demands on the river, how can we protect users from poor water quality conditions? Do we know when it is safe for primary or secondary recreational contact (e.g., when bacterial or algal indicators are high)?

**Gaps:**

- Need a tool linking short-term weather forecast to create local water quality forecasts to warn and inform public recreational users of water quality conditions for primary and secondary contact.

### *Potential Pilot Project, Benefits, and Partners*

**Pilot Project: Develop a decision support system initially focused on spill response.**

This project would focus on enhancing existing modeling capabilities of the Ohio River Community Hydrologic Engineering Centers River Analysis System (HEC-RAS) model and reducing uncertainty by: 1) increasing the number of stream gages measuring flow and velocity;

2) generating better topographic/bathymetric information; 3) expanding coverage to upstream tributaries; and 4) adding a water quality component. The pilot project would also involve the creation of a GIS database with detailed land use data, location and performance of green infrastructure (from local, state and federal agencies that have funded the green infrastructure), link to existing databases (e.g., Integrated Risk Information System (IRIS) database for toxicity, treatability), and locations of hazardous materials/wastes stored at existing facilities/sites across the entire Ohio River Basin. To be useful, a common format and set of standards would have to be established for stakeholder data input. Initially, this pilot would support spill response management efforts; however, once established it could be used to make recreational and other water quality-related decisions.

**Key Benefits of this Project:**

1. Increases public confidence in safety (spills and recreation), particularly since 5 million people use the main stem of the river for drinking water

2. Risk assessment – Beneficiaries include community resilience planners, asset management managers, insurance industry, and shipping/other private sectors.

3. Improved transparency and communication

4. Public health protection

5. Community/public relations (i.e., loss of public confidence per the recent West Virginia spill)

6. Leverages expenditures on existing Ohio River Community HEC-RAS model (money saved, bigger "bang for your buck")

**Key Partners:**

- FEMA (risk assessment)
- State agencies
- Water utilities (intake locations)
- ORSANCO (communication with states, drinking water, and industries)
- EPA
- Coast Guard (data on barges)
- Ohio Kentucky Indiana (OKI) Regional Council of Governments

**Data sources:**

- Electric Power Research Institute (EPRI)
- Shipping companies

- Railroads
- Chemical companies

**Additional pilot project, discussed by the group earlier in the day:** Link short-term weather predictions with projected river water quality forecasts at key recreational locations. Provide access to this "surf report" in a public smart phone app designed for kayakers and other secondary contact recreationists to predict if safe bacteria levels will likely be exceeded.

## Water Supply

### *Key Decisions/Questions and Gaps that IWRSS Could Fill*

**Question #1:** What will future water needs/withdrawals look like and how will they be managed (i.e., competition between users given unknowns in the future water budget)? Users include agriculture, development, river commerce, and energy production. Variables include climate change impacts, land use changes, and withdrawal levels.

**Gaps:**

- Information on total consumptive use, including nomadic water withdrawals and dead end source (e.g., fracking)
- Information on inter-basin transfers
- Lack of central storage for individual state plans, policies, etc. Currently each state has its own individual water use plan.
- Better predictive tools for water use, which will require current and future information on agricultural, development, commerce, and energy production user requirements.

**Question #2:** What will the future water budget look like due to impacts brought on by climate change?

**Gaps:**

- Better climate change predictive tools (including the science and assumptions that go into the models) e.g., meteorological and hydrologic tools
- An economic valuation of water
- Need improvement for state-level drought response plans (overall watershed plan needed)
- Water requirements to support ecosystems

**Question #3:** Can we develop models that more effectively support source water protection?

**Gaps:**

- Information on where the potential contaminants exist
- Need to identify, quantify, and rank contaminants based on risk (e.g., storage tanks,

locating those sources)

- Improved hydrologic modeling for spill scenarios
- Communication gap across states, regions, localities
- Assessments of non-point runoff (impacts treatability of water supply)

### *Potential Pilot Project, Benefits, and Partners*

**Pilot Project: Develop a model for water budget (water in/out) including future climate change scenarios, a common central data portal, and GIS capability.**

Critical to the development of the model would be determining appropriate inputs:

- Stream flow data; aquifer levels; recharge; precipitation data; snow water content; etc.; outflow from industrial, agriculture, inter-basin transfers including cryptic transfers, municipal supplies and sewage treatment systems. (There are significant unknowns associated with cryptic inter-basin transfers.)

Some potential outputs include:

- Streamflow under various scenarios (droughts, floods, extremes vs. average)
- Water budget (source, use, surplus numbers)
- Forecasting based on future climate scenarios
- All outputs would be probabilistic in nature
- Downscaled climate model results

**Key Benefits of this Project:**

1. State governments in the basin would buy into integrated resource management. Integrated resource management includes:
    - Navigation
    - Risk assessment – Identify the most vulnerable infrastructure and communities
    - Reservoir development
    - Resource continuity – e.g., keeping power plants on line and delivering fuel (e.g., coal via barges)
    - Downscaled results to feed into existing local tools
    - Understanding available supply for growth, export, "recruiting" purposes, etc.
    - Basis for regulation, conservation, and other tradeoffs with economic initiatives

Additional examples of potential benefits include:

2. City of Decatur is very drought prone. If a city loses industrial supply due to drought, such a condition would impact the presence of key "economic foundation" companies.

3. Businesses and investors are looking at available water resources to identify where to invest dollars for energy production.

**Key Project Partners:**

- NOAA (climate, weather, temperature, precipitation data)
- USGS (streamflow data, groundwater)
- USACE (initial project underway to identify at risk infrastructure)
- State Departments of Natural Resources
- FEMA (existing models focused on higher flow)
- EPA (looking at impacts of water quality on species)
- State agencies (have the data)
- ORSANCO
- Academia (partner with academia to ground truth information, data entry, etc.)
- U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) farm and ranch irrigation survey (coming out 2015)

***Photo: Bob Sneed, USACE***

## Fish and Aquatic Habitat

### *Key Decisions/Questions and Gaps that IWRSS Could Fill*

**Question #1:** How do we put value on the aquatic/ecosystem services systems? How do we convey that value to the public?

**Gaps:**

- Evaluation of watersheds, backwater wetlands, inundated pools – do not know ecological services they provide.
- Overlay data state and federal agencies have collected about populations over the years with flow data, temperature, topography, etc.

**Question #2:** How to address native, exotic, and invasive species and erosion/sedimentation?

**Gaps:**

- Monitoring, including citizen-scientists
- Overlay data state and federal agencies have collected about populations over the years with flow data, temperature, topography, etc.
- Climate change information (study ongoing)

**Question #3:** How to address connectivity issues in the watersheds (culverts, low dams, roads)?

**Gaps:**

- Need overlay of barriers (structures such as dams, culverts, roads) that restrict flow and disrupt connectivity (from local agencies)
- Need climate change information (study ongoing)

### *Potential Pilot Project, Benefits, and Partners*

**Pilot Project: Prepare requirements for the data base/services that establish the value of aquatic habitats.**

There could potentially be many applications for the database or data service where existing data would be collected and standardized:

- Ecosystem service studies
- Water quality assessments
- Scenic river designations
- Ecosystem health assessments
- Navigation
- Flood management

There would need to be acceptable standards for the data (e.g., Ohio Data Credibility Law). Accessibility to the data would also be critical.

**Key Benefits of this Project:**

1. Beneficiaries include regulatory agencies, local agencies, scientific community, home owners, local governments, regulated community, non-governmental organizations (NGOs)

2. Convenience and efficiency

3. Reliability, accuracy, accessibility, and user friendliness of data services

**Key Project Partners:**

- Fish and Wildlife (state and Federal)
- DOT
- IWRSS Partners
- EPA
- State and regional planning agencies (e.g., OKI)
- NGOs (e.g., The Nature Conservancy) and other end users

## Summary of Nashville Break Out Group Discussions

Participants in each group are listed below (the full participant list can be found in Appendix A).

| Water Quality | Water Supply | Flooding |
|---|---|---|
| Dorie Bolze<br>Tania Datta<br>Paul Davis<br>Sam Dinkins<br>Timothy Hall<br>Mekayle Houghton<br>Mary Mullusky<br>Randy Payne<br>Trent Schade<br>Bob Sneed | Amanda Bowen<br>Craig Carrington<br>Dixie Cordell<br>Gwen Griffith<br>George McKillop | Alfred Kalyanapu<br>Kelie Hammond<br>James LaRosa<br>Larry Vannozzi<br>Ken Weidner<br>Shannon Williams |

## Water Quality

### *Key Decisions/Questions and Gaps that IWRSS Could Fill*

**Question #1:** If we make these watershed land use changes, what is the impact on local water quality? Water quality is not often accounted for when weighing advantages/disadvantages of land use decisions, especially outside jurisdictional boundaries regulated by Municipal Separate Storm Sewer System (MS4) permits.

**Gaps:**

- We need a "video game," user-friendly app, or interface that local planner or Town manager can use to visualize potential land use scenarios at a small scale.
- Information on the cost/value of water quality.
- Higher resolution land cover data, directly connected impervious area, buffer quality, etc.
- Quantitative loading/waste data on agricultural inputs.
- Future scenarios (e.g., uncertainly around climate change).
- Lack of information to advocate and educate.

**Question #2:** Can we improve the water quality standards for parameters such as temperature and DO to better protect aquatic resources in a changing climate?

**Gaps:**

- Ability for policy to handle adaptive management
- Need for a new end point for criteria
- Biological information
- Ability to predict how future climate or land use inputs, future withdrawals, etc. may shift baseline parameters; need more long-term predictions.
    - Will native river temperatures be warmer in the future and what does this mean for electric plant operations?
    - What is the environmental cost of a one-degree temperature change in the reservoir? TVA has good real-time info currently, but is looking for 2D or 3D models.
    - What if there are more frequent and longer droughts and USACE doesn't have supplemental flow to release?
    - What if the number of inputs or volume withdrawn changes (e.g., shift to new and higher-water-demanding crops due to climate change)?

**Question #3:** How do you decide to invest in point vs. non-point source projects? For example, are significant capital expenditures to upgrade treatment plants more cost-effective than implementation of wide-scale, strategic non-point source controls?

**Gaps:**

- Quantification of non-point loads to help evaluate where the real risk to public health is (point or non-point). We know dry weather flows are an issue, but don't have a good grasp on stormwater loads.
- Data on organic loadings and emerging contaminants
- BMP effectiveness
- Tools or mechanisms for trading (e.g., trading pilot program for Miami River).

### *Potential Pilot Project, Benefits, and Partners*

**Pilot Project: Predictive tool connecting climate and land-use change to evaluate water supply and water quality**

The project would create a predictive tool connecting regional climate and localized land-use changes to evaluate impacts on water supply and water quality. A user-friendly interface for this tool will give us the capability to visualize and quantify the impact of various watershed land use and treatment scenarios to better inform local decision makers on the true cost of land use decisions. It will include a mechanism for cost comparisons to help evaluate investment options in pollution reduction approaches. This project is envisioned as a living, adaptable mechanism to supplement (or provide an alternative to) the static total maximum daily load (TMDL) process.

**Key Benefits of this Project:**

1. Help to evaluate operational cost savings and capital investments vs. green infrastructure costs. For example, Cincinnati and Pittsburg will be spending $3 billion to upgrade wastewater treatment plants.
2. The tool helps us understand impact of high growth areas such as industrial agriculture and urban sprawl.
3. The tool helps quantify non-point source loads.
4. Showing that land use change is a key part of the modeling and helping to answer the question about the impact of future land use on water resources (both quality and quantity) - Is the result good or bad?
5. Helps communicate to a broad audience and explain decisions. The tool helps show the option that meets a water quality target at the least cost.
6. Foster multi-jurisdictional relationships. Local, regional, national. Fosters collaboration between the regulated and un-regulated communities (e.g., treatment plant operators and farmer trading collaboratives).

7. Supplements (or is alternative to) TMDL development, possibly helping to delist impaired rivers. TMDLs are static, but this project could produce a "living" TMDL that changes and adapts to conditions over time.

**Key Partners:**

- EPA (to develop modeling)
- GIS data owners (Counties, regions with information about land-use, soil-type, temperature, precipitation, flow)
- Cumberland River Compact
- Harpeth River Watershed Association
- USDA NRCS
- Metro Nashville
- TVA

## Water Supply

### *Key Decisions/Questions and Gaps that IWRSS Could Fill*

**Question #1:** What is the optimal hydrologic water balance?

**Gaps:**

- Better quantification/understanding of currently reported water balance
- Understanding of optimal flows for streams, not just flow minimums
- Uncertainty levels around USGS water projections (5 year), USDA county-level consumptive factors (yearly)
- Information on source of groundwater and groundwater levels, stream, etc.

**Question #2:** What are demand/consumptive use/withdrawals? Where? When?

a. What/how much water is being taken out and where is it being put back in?
b. How will upstream withdrawals and demand impact downstream users and reservoirs?
c. How does this impact power generation?

**Gaps:**

- Accurate population growth rates, water consumption rates, land use changes
- A better quantification of unreported withdrawals and returns

**Question #3:** How to manage for optimal flows?

a. How do we project optimal water supply given population growth to inform project decisions (e.g. inter-basin transfers, additional reservoir)?

b. How do we manage flows currently and in the future for flow targets/species of concern?

**Gaps:**

- Same gaps as Question #1.
- Climate projections to assist with future regional planning for drought situations, future hydrologic conditions (extremes).
- Build out projections to predict future water demand, future water quality.

### *Potential Pilot Project, Benefits, and Partners*

**Pilot Project: Model and model interpretation (reports, etc.) of future scenarios showing uncertainty in demand and ecological requirements due to climate changes.**

This project would model different downscaled climate change scenarios (low, medium, high emissions) and for each scenario, show how the range of factors under local control (e.g. population growth, industry changes for major water users and estimate of their use) that influence water supply. There is potential overlap with current modeling efforts with the Nashville Metropolitan Planning Organization (MPO) and TVA.

**Key Benefits of this Project:**

1. This will allow for protection of source waters, valuation of water as an ecosystem service, and better management for competing uses
2. Would be useful for reservoir management in drought (water supply and water quality)
3. Planning tool to help cities and municipalities understand water availability for new industries (educate on where to location construction/investments)
4. Inform permitting decisions
5. Improve reliability of water sources, increasing economic investments/development
6. Could get more accurate baseline numbers of industry water use , and help inform policy to address this gap
7. Local water providers would receive better background for decision-making
8. Possibly sustain or reduce inter-basin transfers

**Key Project Partners:**

- Nashville MPO and Cumberland River Compact (MPO goal is to use regional planning process to inform comprehensive planning process)
- NWS (climate, drought modeling)

- USGS (drought reports, stream gauges)
- USACE (watershed modeling)
- USFWS (information about in-stream flows)
- State and local governments (plans)
- USDA (information about ecosystem services of agriculture, provide current water use estimates)
- U.S. Forest Service (ecosystem services of forests)

**Boat ramp construction, Cumberland River, Nashville, TN.** ***Photo: Bob Sneed, USACE***

## Flooding

### *Key Decisions/Questions and Gaps that IWRSS Could Fill*

**Question #1:** How can we better support local emergency managers in their decisions? What is the best way to do this (e.g. use of on-site staffing from one agency such as NWS)?

**Gaps:**

- Slow pace of implementation of new capabilities
- Information clearing houses – make information more accessible

**Question #2:** How can we create better forecasts? What level of accuracy in light detection and ranging (LIDAR) and other data are needed? How can we make data more reliable?

**Gaps:**

- Monitoring networks (stream gauge, soil moisture, precipitation, evaporation, water quality)
- Inundation mapping and graphical warning system
- Better and more accessible spatial data (e.g. bathymetry)
- HEC-RAS improvements (to account for wind)
- Probability (risk) information (forecasts and inundation maps) connected to FEMA Hazus analyses (property damages due to flooding)

**Question #3:** How do we effectively communication information during events? How to keep event from getting sensationalized (over-sensationalizing creates complacency)?

**Gaps:**

- Lack of situational awareness on the part of people reporting on events.
- Communications protocols are clear for dam breaks but not so much for other events.

### *Potential Pilot Project, Benefits, and Partners*

**Pilot Project: Citizen-Scientist Data Collection.**

Install weather stations with soil moisture sensors at schools and universities to create more complete networks. Project would be implemented with an engaged school district that has bought into the idea of collecting meteorological and soil moisture data. The schools would host and run the stations with the assistance of universities and/or qualified climate scientists. Mill Creek and Whites Creek watersheds were mentioned as potential pilot watersheds. The project would likely work best in basins of 100 square miles or less. Like some previous collaborative efforts in the state, the private sector could provide funding for the installation of the stations (e.g. Nestlé monitoring and engagement effort). Some considerations/challenges would be placement of sensors, maintenance, and data quality.

**Key Benefits of this Project:**

1. Better/more complete data: better forecasts; improved flood inundation mapping, improved modeling, which benefits public, universities and federal agencies.
2. Improved public awareness and engagement: If students develop a strong understanding of weather issues at a young age, they are able to educate their parents.
3. Cost sharing: private-public partnerships.

**Key Project Partners:**

- IWRSS Partners
- Local governments

- Local schools and universities
- Private sector
- Any groups in target watershed (e.g. Mill Creek and Whites Creek)

# APPENDIX A
# Stakeholder Lists

# Integrated Water Resources Science and Services (IWRSS):
## *A Forum to Discuss this New Federal Initiative*

***Ohio River Basin – Upper Basin***
***Cincinnati, Ohio***
***June 25, 2014***

## Final Participant List

**Christina Baysinger**
US Army Corps of Engineers - LRD
550 Main Street
Cincinnati, OH 45202
513-684-2237
christina.m.baysinger@usace.army.mil

**Elly Best**
Office of Research & Development
U.S. EPA
25 West Martin Luther King Drive
Cincinnati, OH 45268
513-569-7517
best.elly@epa.gov

**Bill Caldwell**
Environmental Scientist
Kentucky Division of Water
200 Four Oaks Lane
Frankfurt, KY 40601
502-564-3410
bill.caldwell@ky.gov

**Brian Carr**
Environmental Resources
Program Manager
West Virginia DEP
601 57th Street, SE
Charleston, WV 25304
304-926-0499
brian.a.carr@wv.gov

**John Cheek**
Maintenance Program Manager
US Army Corps of Engineers
550 Main Street
Cincinnati, OH 45202
513-684-3029
john.d.cheek@usace.army.mil

**Emily Class**
Ohio Department of
Natural Resources
2045 Morse Road
Columbus, OH 43229
614-265-6729
Emily.Class@dnr.state.oh.us

**Rich Cogen**
Ohio River Foundation
4480 Classic Drive
Cincinnati, OH 45241
513-460-3365
rcogen@ohioriverfdn.org

**Sam Dinkins**
Manager, Water Resources
ORSANCO
5735 Kellogg Avenue
Cincinnati, OH 45230
513-231-7719 x108
sdinkins@orsanco.org

**Jennifer Eismeier**
Executive Director
Mill Creek Watershed
Council of Communities
1223 Jefferson Avenue
Cincinnati, OH 45215
513-563-8800
Jeismeier@
millcreekwatershed.org

**Mike Ekberg**
Manager Water Monitoring
Miami Conservancy District
38 E. Monument Avenue
Dayton, OH 45402
937-223-1278 x3237
mekberg@miamiconservancy.org

**Erich Emery**
Regional Water Quality Specialist
U.S. Army Corps of Engineers
550 Main Street
Cincinnati, OH 45202
513-684-3041
erich.b.emery@usace.army.mil

**Jim Goodrich**
Acting Director, Water
Infrastructure Protection Division
Office of Research & Development
U.S. EPA
26 West Martin Luther King Drive
Cincinnati, OH 45268
513-568-7605
goodrich.james@epa.gov

**Mike Griffin**
Deputy Director
USGS - INKY WSC
9818 Bluegrass Parkway
Louisville, KY 40299
502-493-1913
mgriffin@usgs.gov

**Sally Gutierrez**
Director
U.S. EPA
26 West Martin Luther King Drive
Cincinnati, OH 45268
513-569-7683
gutierrez.sally@epa.gov

**Ben Haggerty**
Green Streets LLC
1618 Sycamore Street
Cincinnati, OH 45202
513-257-5256
Haggerty.Benjamin@
Green-Streets.net

**Teresa Harten**
Team Lead Water
Technology Innovation
Cluster
U.S. EPA ORD
26 West Martin Luther
King Drive
Cincinnati, OH 45229
513-569-7565
harten.teresa@epa.gov

**Evelyn Hartzell**
Environmental Engineer
NRMRL/U.S. EPA
26 West Martin Luther
King Drive
Cincinnati, OH 45268
513-569-7728
hartzell.evelyn@epa.
gov

**Jason Heath**
Technical Programs
Manager
ORSANCO
5735 Kellogg Avenue
Cincinnati, OH 45230
513-231-7719
jheath@orsanco.org

**Kristy Hopfensperger**
Northern Kentucky
University
1 Nunn Drive - SC 228
Highland Heights, KY
41099
859-572-5305
hopfenspek1@nku.edu

**Scott Jackson**
Deputy Director
USGS Ohio Water Science Center
6480 Doubletree Avenue
Columbus, OH 43229
614-430-7707
sjackson@usgs.gov

**Carey Johnson**
CTP Program Manager
Kentucky Division of Water
200 Fair Oaks Lane - 4th Floor
Frankfort, KY 40601
502-564-3410 x4928
Carey.johnson@ky.gov

**Scott Kirk**
Environmental Scientist
Ohio Department of
Natural Resources
2045 Morse Road
Columbus, OH 43229-6693
614-265-6742
scott.kirk@dnr.state.oh.us

**Tara Lanier**
Corporate Environmental Coordinator
Marathon Petroleum Company
539 South Main Street
Findlay, OH 45840
419-421-4171
tllanier@marathonpetroleum.com

**Ted Lozier**
Chief of Conservation
Muskingum Watershed
Conservancy District
1319 Third Street, NW
P.O. Box 349
New Philadelphia, OH 44663
330-556-4840
tlozier@mwcd.org

**John Mangan**
Mill Creek Watershed
Council of Communities
3769 Ault Park Avenue
Cincinnati, OH 45208
513-368-2334
jmangan1966@gmail.com

**Rhonda Manning**
River Basin Program Coordinator
Pennsylvania Department of
Environmental Protection
400 Market Street
Harrisburg, PA 17105
717-772-4472
rmanning@pa.gov

**John Menninger**
Water Resources Engineer
Stantec
11687 Lebanon Road
Cincinnati, OH 45241
513-842-8200
john.menninger@stantec.com

**Michael C Miller**
Professor Emeritus, Dept.
Biological Sciences
University of Cincinnati
3348 Meyer Place
Cincinnati, OH 45211
513-676-0293
Mike.Miller@UC.edu

**Gregory Nageotte**
Watershed Program Manager
Ohio Department of
Natural Resources
2045 Morse Road, B-3
Columbus, OH 43229-6693
614-265-6619
greg.nageotte@dnr.state.oh.us

**James Noel**
Service Coordination Hydrologist
NOAA
National Weather Service
Ohio River Forecast Center
1901 South Street Rt 134
Wilmington, OH 45177
937-383-0528
James.Noel@noaa.gov

**Trent Schade**
Hydrologist in Charge
Ohio River Forecast Center
1901 South State Route 134
Wilmington, OH 45177
937-383-0528
trent.schade@noaa.gov

**Mindy Scott**
SD1
1045 Eaton Drive
Ft. Wright, KY 41017
859-578-6743
mscott@sd1.org

**Tre Sheldon**
Green Streets LLC
1618 Sycamore Street
Cincinnati, OH 45202
513-410-1500
tresheldon@hotmail.com

**Charles Somerville**
Dean
Marshall University
College of Science
One John Marshall Drive
Huntington, WV 25755
304-696-2424
somervil@marshall.edu

**Gary Springston**
Tennessee Valley Authority
1101 Market Street - LP 3D
Chattanooga, TN 37421
423-751-7336
glspringston@tva.gov

**Frevert Toby**
ORSANCO
2140 Huff Road
New Berlin, IL 62670
217-891-0772
toby.frevert@gmail.com

**Bruce Whitteberry**
Assistant Superintendent
Greater Cincinnati Water Works
5651 Kellogg
Cincinnati, OH 45230
513-624-5611
bruce.whitteberry@
cincinnati-oh.gov

# Integrated Water Resources Science and Services (IWRSS):
## *A Forum to Discuss this New Federal Initiative*

***Ohio River Basin – Lower Basin***
***Cumberland River Compact***
***Nashville, TN***
***June 26, 2014***

## Final Participant List

**Dorie Bolze**
Executive Director
Harpeth River Watershed Association
P.O. Box 1127
Franklin, TN 37065
615-479-0181
doriebolze@harpethriver.org

**Amanda Bowen**
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402
423-751-2271
akbowen@tva.gov

**Craig Carrington**
US Army Corps of Engineers
110 9th Avenue South
Nashville, TN 37203-3863
615-736-7861
Craig.D.Carrington@usace.army.mil

**Stephanie Chance**
USFWS
446 Neal Street
Cookeville, TN 38501
931-528-6481 x211
stephanie_chance@fws.gov

**Dixie Cordell**
Engineer
Southeastern Power Administration
1166 Athens Tech Road
Elberton, GA 30635
706-213-3851
dixie.cordell@sepa.doe.gov

**Tania Datta**
Assistant Professor
Tennessee Tech University
Box 5033
Water Resources Center
Cookeville, TN 38505
931-372-3446
tdatta@tntech.edu

**Paul Davis**
Cumberland River Compact
45 Burris Court
Mount Juliet, TN 37122-2376
615-758-8647
pedh2o@gmail.com

**Sam Dinkins**
Manager, Water Resources
ORSANCO
5735 Kellogg Avenue
Cincinnati, OH 45230
513-231-7719 x108
sdinkins@orsanco.org

**Gwenn Griffith**
Program Director
Cumberland River Compact
2 Victory Avenue Suite 300
Nashville, TN 37213
615-837-1151
Gwenn.griffith@cumberlandriverc
ompact.org

**Timothy Hall**
Water Quality Manager
Evansville, IN. Drinking Water
1301 Waterworks Road
Evansville, IN 47713
812-428-0568
thall@ewsu.com

**Kelie Hammond**
Tennessee Valley Authority
400 W. Summit Hill Drive
WT 10C
Knoxville, TN 37902
865-632-2906
khhammond@tva.gov

**Mekayle Houghton**
Executive Director
Cumberland River Compact
2 Victory Avenue Suite 300
Nashville, TN 37213
615-837-1151
Mekayle.Houghton@Cumberland
RiverCompact.org

**Alfred Kalyanapu**
Assistant Professor
Tennessee Technological
University
1020 Stadium Drive - Box 5015
Cookeville, TN 38505
931-372-3561
akalyanapu@tntech.edu

**James LaRosa**
Service Hydrologist
National Weather Service
500 Weather Station Road
Old Hickory, TN 37138
615-754-8500 x228
james.larosa@noaa.gov

**Scott Potter**
Director of Water Services
Metro Water Services
1600 Second Avenue North
Nashville, TN 37208
615-862-4505
scott.potter@nashville.gov

**Trent Schade**
Hydrologist in Charge
Ohio River Forecast Center
1901 S. State Route 134
Wilmington, OH 45177
937-383-0528
trent.schade@noaa.gov

**Bob Sneed**
Water Management Section Chief
Nashville District Corps of
Engineers
PO Box 1070
Nashville, TN 37202-1070
615-736-5675
robert.b.sneed@usace.army.mil

**Larry Vannozzi**
Meteorologist-in-Charge
National Weather Service
Nashville
500 Weather Station Rd
Old Hickory, TN 37138
615-754-8500 x222
larry.vannozzi@noaa.gov

**Ken Weidner**
Director
Sumner County Emergency
Management Agenc
255 Airport Road
Gallatin, TN 37066
615-452-7584
kweidner@sumnerema.org

**Shannon Williams**
Supervisory Hydrologist
USGS, Tennessee Water Science
Center
640 Grassmere Park, Suite 100
Nashville, TN 37211
615-837-4755
swilliam@usgs.gov